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COMPRESSOR

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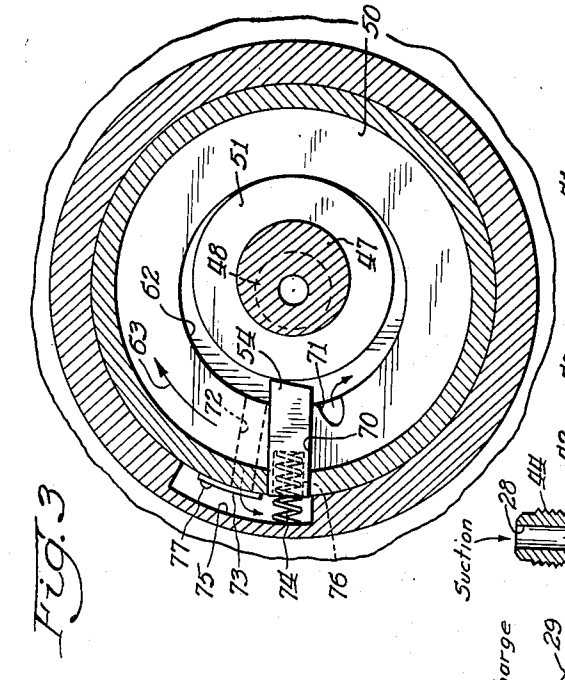


Fig. 3

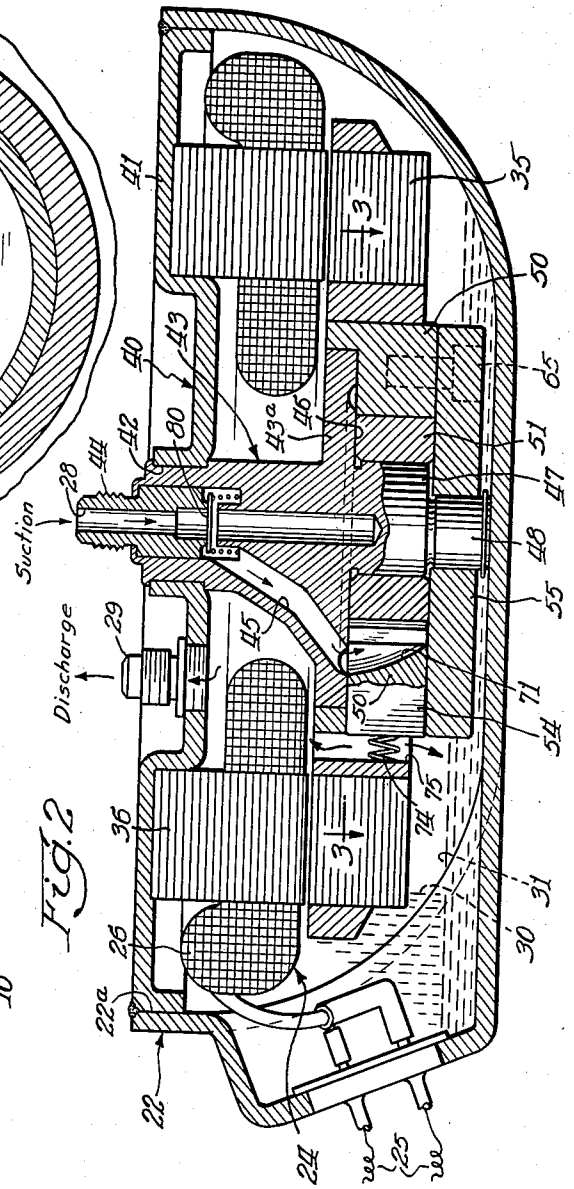


Fig. 2

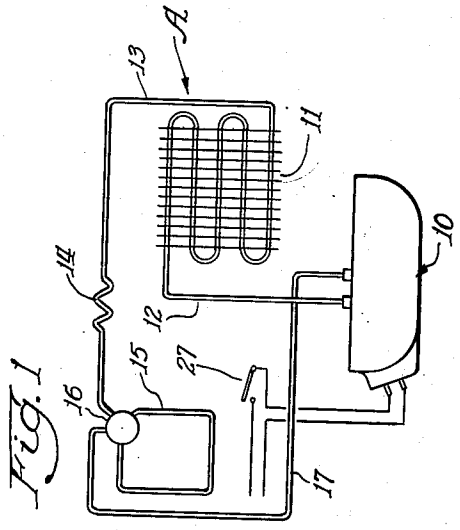


Fig. 1

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COMPRESSOR

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This invention relates in general to refrigerating apparatus and has reference to an improved form of compressor construction therefor.

Otherwise stated, the invention is embodied in refrigerator compressor constructions and is directed to simplify the structural features thereof and their mode of operation and to provide a refrigerant compressor which may readily and conveniently be employed universally to various types of refrigerating systems presently being commercially exploited.

Moreover, the present device seeks to employ conventional parts wherever necessary and possible, thereby to effect a further substantial reduction in the cost over the prevailing types of refrigerant compressors presently being employed.

More specifically stated, it is a general object and accomplishment of the invention to provide a compressor construction which is particularly adaptable for employment in a refrigerating system of the type wherein a refrigerating medium is circulated through a closed system and is successively compressed in a gaseous state, condensed into a liquid and then expanded by evaporation at a relatively high pressure, the invention being particularly concerned with a compressor of the type generally applicable for employment for domestic or other uses where individual units of relatively small capacity are employed and has particular relation to an improved arrangement of parts having special application as a combination refrigerant motor and compressor unit.

Another aspect of the invention is to provide a motor compressor combination unit having an improved arrangement of elements forming a sealed housing refrigerant compressor assembly having the minimum over-all co-axial dimension while maintaining a high efficiency of operation and effecting a reduction in the cost of manufacturing over that of similar units of present manufacture.

Another object and accomplishment of the invention is to provide an improved refrigerating system by co-relating and especially designing the various elements of the motor compressor combination units to effect advantageous cooperation between said improved elements as will best serve the purpose of providing an efficient system capable of being manufactured at low cost and yet giving the maximum of satisfactory service in use.

A further object and accomplishment of the

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invention is to provide an improved unit designed for refrigeration purposes which shall have a novel and compact arrangement of parts wherein said parts can be readily assembled and serviced.

It is a more detailed object of the invention to provide a motor compressor unit of the above type and having an improved lubricating arrangement for insuring the delivery of the necessary lubricant to each of the vital moving parts.

It is another detailed object and accomplishment of the invention to provide a motor compressor unit for refrigeration purposes and employing an axial air gap motor as a power source.

An ancillary object and accomplishment of the invention is to provide a new and improved motor compressor unit which is adapted to be economically manufactured and which is so designed as to permit the manufacture and assembly thereof in accordance with present day large scale mass production manufacturing methods of construction and assembly.

The invention seeks, as a further object and accomplishment, to provide a motor compressor unit particularly characterized by a design arrangement to more advantageously and satisfactorily perform the functions required of it and adapted to provide a compact unit which will successfully combine the factors of structural simplicity and durability, and yet be economical to manufacture.

Additional objects, features and advantages of the invention disclosed herein will be apparent to persons skilled in the art after the construction and operation are understood from the within description.

It is preferred to accomplish the various objects of this invention and to practice the same in substantially the manner as hereinafter more fully described, and as more particularly pointed out in the appended claims.

Embodiments of the invention are illustrated in the accompanying drawings forming a part hereof and wherein:

Fig. 1 diagrammatically illustrates a refrigerating system incorporating the refrigerant motor compressor unit embodying the features of the present invention;

Fig. 2 is a sectional view of a motor compressor unit contemplated by this invention; and

Fig. 3 is a sectional view of a portion of the refrigerant motor compressor unit depicted in Fig. 2 and being taken substantially on the plane of the line 3—3 in Fig. 2.

The drawings are to be understood as being more or less of a schematic character for the purpose of illustrating and disclosing a typical or preferred form of the improvements contemplated herein and in the drawings like reference characters identify the same parts in the several views.

Heretofore, in prior art compressor constructions such units were usually disposed in a machinery compartment forming a part of the lower portion of a refrigerator cabinet. In such applications the specific requirements of space were not of paramount importance and the forward part of the cabinet adjacent the machinery compartment was provided with a hinged vegetable bin in an effort to utilize some of this space. In recent years, the cubicle content of a refrigerator has become a very important item and, therefore, it has become necessary to find ways and means to effect reduction of the size of the mechanical elements of a refrigerator so as to provide, as much as possible, more usable space in the food compartment. It has been found that this can be accomplished in several ways. For example, the compressor may be reduced in size, thereby requiring a smaller machinery compartment, or, because of the reduction in size, the compressor and condenser forming a part of the mechanical structure of a refrigerator may be disposed on the back side of the refrigerator cabinet in the upper regions thereof adjacent the evaporator, thereby eliminating the necessity of a machinery compartment in the lower portion of the cabinet. This position of the compressor as described would permit utilization of the space, formerly occupied by the mechanism, as a part of the food storage compartment.

It is recognized that in the prior art numerous attempts have been made to provide a relatively small refrigerant compressor unit and yet maintain the desired capacity of the unit, but to the best of the applicants' knowledge, only very few of the prior art structures have had limited successful applications and have been accorded only limited commercial recognition.

It is believed that this fact results from the deficiencies of the prior art structures, and their non-adaptability to effectively overcome the difficulties hereinbefore set forth.

As one possible example of advantageous employment of the combination refrigerant compressor motor unit, reference is made to the drawings, particularly Fig. 1, wherein there is illustrated the refrigerant motor compressor unit with which the present invention is particularly concerned and designated in its entirety by the numeral **10** as being adjunctively employed, for example, with a conventional refrigerating system designated in its entirety by the letter A.

The illustrated refrigerating system may comprise the compressor **10**, herein shown as being of the hermetically sealed type and a directly connected condenser **11**. After undergoing compression, the hot refrigerant flows through a discharge line **12** and through the convolutions of the condenser **11** which is air-cooled in the conventional manner, this extraction of heat being effective to reduce, in some degree, both the pressure and the temperature of the refrigerant, although both are quite high compared to normal atmospheric conditions.

After the mixed vapors and liquid refrigerant are discharged from the condenser, they will flow through a conduit **13** into a valving device, which in this particular case is illustrated as a capillary

tube or restrictor **14**, which is connected to an evaporator **15** having a header **16**. It is notable that the refrigerant is throttled in passing the restrictor **14**, and, thereafter, will be expanded at the discharge side of the restrictor and will be further expanded in the evaporator so that it will become quite cooled and is, therefore, capable of absorbing heat from the storage compartment of the refrigerator and from the contents thereof. After making its circuitous path through the evaporator, the expanded and expended refrigerant is then returned to the compressor **10** by means of a suction line **17**, thus completing the closed circuit.

Suffice it to say, since the invention is not particularly concerned with the precise construction of the entire refrigerating system as illustrated, and/or its associated parts, they will not be further described in detail, and it is deemed sufficient for all intentions and purposes herein contained to show only portions thereof adjacent to and cooperating with the motor compressor unit contemplated herein. It is to be understood that details of construction of such refrigerating systems with which the refrigerant motor compressor unit contemplated herein may advantageously be employed, and/or their associated parts, may be modified to suit particular conditions or to satisfy the engineering genius of various manufacturers, and we do not wish to be limited to the construction of these elements as set forth except where such construction particularly concerns the invention contemplated herein.

Having thus described, by way of example, a possible adaptation of the sealed motor compressor unit and having described the general environment surrounding the adaptation, the specific construction and function of the parts of said sealed motor compressor unit will now be described in detail.

In the exemplary embodiment of the invention depicted in Fig. 2, the compressor **10** is shown as being enclosed within a gas tight housing or casing indicated generally at **22**, with an electric motor indicated generally at **24** and which is illustrated as being constructed in part integrally with the casing **22** and arranged as a power source for operating the compressor. The construction of the motor **24** is a unique feature of the invention and preferably is of the alternating current type and adapted to be supplied with electrical energy through suitable conduits **25** operatively connected to the motor windings indicated generally at **26** and which are arranged internally of the casing **22**. Electric current may be supplied to the motor for operating the same at intermittent periods and the supply of current to the motor may be under the control of a switch **27** which is operatively associated with the evaporator or freezer element **15** of the refrigerating system so that the compressor may be operated in such a way as to maintain the temperature thereof, and of the heat insulated compartment within which such evaporator may be arranged, within said predetermined temperature limits.

In the construction illustrated in Figs. 2 and 3, the compressor **10** is arranged within the gas tight casing **22** and the vaporous refrigerant from the evaporator is supplied to the intake side of the compressor through the suction port **28** via the suction line **17**. The refrigerant is discharged from the compressor into the interior of the casing **22** and the refrigerant is conducted from the casing **22**, through the discharge port

29 by means of the conduit 12, to the condenser 11. The casing 22 functions as a lubricant reservoir and the lubricant therein preferably stands to a level indicated by the line 30 or 31, in Fig. 2, depending on whether the compressor is mounted on a vertical or horizontal plane, and the lubricant is subjected to the discharge pressure of the compressor. Because the refrigerant medium is supplied to the evaporator element 15 under control of a suitable refrigerant expansion control, such as a low side float or the like, the space within the casing 22 and the condenser 11 constitute the high pressure side of the refrigerating system.

A lubricant is provided for lubricating the working parts of the system such as the moving parts of the compressor 10 and the motor, and some of the lubricant will circulate with the refrigerant throughout the system; however, a body of lubricant will collect within the lower part of the casing 22, and to such an extent, as to partially submerge the compressor 10 therein. Because the lubricant in the casing is subjected to the discharge pressure of the compressor and because the compressor is partially submerged in the lubricant, the working parts of the compressor will be lubricated and sealed.

The casing 22 comprises a cup-shaped shell and a closure or frame member 40 which may be advantageously fitted into the mouth 22*a* of the shell and welded or otherwise suitably secured thereto, when in operative position, to define a hermetically sealed casing for the compressor unit. It is notable that the frame member 40 is formed to define the shape as shown to take advantage of structural strength and save as much space as possible. The frame member 40 comprises a closure plate 41 provided with a flanged centrally disposed through aperture 42 adapted to receive for fixed securement thereto a central stud-like support indicated in its entirety by the numeral 43, said stud-like support 43 being arranged to receive a suction line connection 44 and is provided with suitable channels such as 45 for the passage of refrigerant. The stud-like member 43 is provided with a substantially circular shaped radially projecting flange 43*a* provided with a finished surface 46 which will form an end plate or closure for the rotary compressor, a circular shaped eccentric 47 which can be seen in Figs. 2 and 3 as being disposed off center from the central axis of the compressor, and projecting axially from said eccentric 47 there is provided a bearing 48.

It is notable that the stator 36 and the motor windings are suitably secured to the closure member 41. It is important to understand that the closure member 41, the stator 36, the stud-like support member 43 including the flange 43*a*, the eccentric 47 and the bearing 48 all remain stationary.

The compressor 10 further includes a cylinder 50, a rotor 51, a divider 54 and an end plate 55. Thus, it can be seen that the flange 43*a* which is provided with the finished surface 46, and the cylinder 50 including the end plate 55, when assembled together, form a closed cylindrical chamber 62 or pumping space in which the rotor 51 is arranged for rotative movement on the eccentric 47. The rotor 51 is freely journaled on the eccentric 47 and, it will be observed, is of less diameter than the pumping chamber 62 in which it is arranged. The rotor 51 is of such size, relative to the cylinder 50, that there is a small working clearance between the

vertical faces of the rotor and the adjacent vertical faces defined by the finished surface 46 and the inside face of the end plate 55. Also, the diameter of the rotor 51 is such that there is a slight clearance between the periphery of the rotor 51 and the adjacent cylinder wall of the pumping chamber 62 at that point where the rotor 51 divides one side of the pumping chamber 62 from the other side thereof, as illustrated in Fig. 3, and this clearance is maintained throughout the operation of the compressor as the cylinder moves around on an axis defined by the center of the compressor body in the direction of the arrow 63 in Fig. 3.

In Fig. 2 it can be observed that the bottom plate 55 is suitably secured to the cylinder 50 by means of the bolts as at 65 and the cylinder 50 is in turn fixedly secured to the rotor 35 of the motor 24. Thus, it can be seen when the compressor is in operation, the cylinder will revolve in the direction indicated by the arrow 63, while the rotor 51 may freely rotate about the eccentric element but, the eccentric element will remain stationary. This arrangement of parts defines important differential characteristics of construction heretofore not found in prior art practice.

The divider 54 is arranged for reciprocation within a slot 70 formed in the cylinder 50 and is disposed so that end portions thereof are in engagement with the periphery of the rotor, as illustrated in Fig. 3, so as to separate the suction gas from the discharge gas in the pumping chamber 62. The divider 54 defines flat surfaces which slide on the flat surfaces of the slot in which the divider 54 reciprocates. The divider 54 preferably is of the same dimension with respect to thickness as the rotor 51, so that the divider 54 will form a movable seal between the periphery of the rotor 51 and the walls of the pumping chamber 62.

The pumping chamber is provided with an intake port as at 71 and with a discharge port 72 preferably, but not necessarily, controlled by a valve as at 73. The divider 54 is reciprocably disposed in the slot 70 and is guided in its movement by a spring 74, one end of which being received into a recess 76 disposed in the end portions of the divider 54 and the other end of the spring being held in engagement with a wall defined by a refrigerant outlet chamber 75 forming a part of the cylinder 50. Spring 74 acts to hold the divider 54 in contact with the periphery of the rotor 51.

The discharge port 72 is cut into portions of the cylinder 50 and opens into the chamber 75 in which the valve 73, which controls the discharge port, is arranged. It can be seen in Fig. 2 that the chamber 75 opens into the body of the casing 22. The valve 73 may be a flap valve or a check valve and is preferably anchored at one end thereof by means of screws as at 77.

In order to prevent a reversal of the pressures during certain operations of the compressor, there is provided a spring pressed valve 80 which is disposed in the suction line and it can be seen that when the compressor is in operation, the suction of the refrigerant coupled with the discharge pressure running through the entire circuit of the refrigerating system and entering the suction conduit 28 will force the valve to open and permit refrigerant to flow through the compressor. When the compressor is not in operation, discharge and suction pressures are not present and, therefore, the spring pressed valve will

be closed to prevent a reverse in the cycle of operation.

Thus, it can be seen that the path of the refrigerant through the compressor is defined by its passage through the suction conduit **28** and past the valve **80** through the conduit **45** and into the compression chamber **62** whereupon the rotary action of the cylinder **50** cooperating with the function of the divider **54** will compress the refrigerant and discharge the same through the discharge port **72** past the valve **73** and into the casing **22** whereupon it may be discharged from the casing **22** by virtue of discharge connections **29** forming a part of the conduit **12**.

It is notable that an important feature of the invention is the unique association of parts, particularly the departure from conventional compressors in that the cylinder, which in prior art constructions remain stationary, is rotated in this case which provides an assembled compressor unit of relatively small co-axial dimension giving the advantage of being able to mount the compressor unit on the back portions of the refrigerator cabinet if desired. In some adaptations it may be desirable to mount the compressor assembly in the conventional lower portions of the refrigerator cabinet. In this connection a minimum of space will be required and any savings in space may be transferred to enlargement of the food storage chambers, this being particularly true when the currently popular long door model refrigerators are employed.

The instant motor compressor combination unit, being formed of simple parts and readily available materials, lends itself to mass production manufacturing principles, thus affording a substantial saving in the manufacturing cost.

From the foregoing disclosure, it may be observed that we have provided an improved combination motor compressor unit which efficiently fulfills the objects thereof as hereinbefore stated and which provides numerous advantages which may be summarized as follows:

1. Structurally simple, efficient and durable;

2. Economical to manufacture and readily adaptable to mass production manufacturing principles; and

3. The provision of a combination motor compressor for refrigeration purposes employing an axial air gap motor as a power source thereby substantially effecting a reduction in the manufacturing cost thereof while providing an improved arrangement of the elements thereof to provide a minimum over-all coaxial dimension while maintaining a high efficiency of operation and thereby effecting a reduction in the cost of manufacturing over that of similar units of present manufacture.

While we have illustrated preferred embodiments of our invention, many modifications may be made without departing from the spirit of the invention, and we do not wish to be limited to the precise details of construction set forth but wish to avail ourselves of all changes within the scope of the appended claims.

We claim:

1. A compressor comprising a stud-like support including an integral stationary eccentric, a rotor mounted on said eccentric for relative rotation therebetween, a compression chamber, a cylinder eccentrically mounted with respect to said rotor and for rotation and surrounding said rotor and eccentric to define said compression chamber, an inlet leading to and an outlet leading from said compression chamber, a divider located between said inlet and said outlet and carried by said cylinder and arranged for rotation therewith and having portions thereof in engagement with said rotor and arranged for reciprocation in said compression chamber responsive to the rotation of the cylinder and the action of the eccentric, in combination with an axial air gap electric motor comprising a stator, a motor rotor fixedly secured to said cylinder, said compression chamber nested within the limits of the motor rotor, whereby said cylinder may be caused to rotate responsive to the rotative forces of the motor rotor.

2. The combination of an axial air gap electric motor and a compressor disposed within a hermetically sealed casing, said compressor comprising a stud-like support having an integrally formed stationary eccentric, a rotor mounted on said eccentric for relative rotation therebetween, a compression chamber, a rotatable cylinder eccentrically mounted in respect to said rotor and surrounding said rotor and eccentric to define said compression chamber, an inlet leading to and an outlet leading from said compression chamber, a divider located between said inlet and outlet and carried by said cylinder for reciprocation in said compression chamber, and said axial air gap motor comprising a stator, and a motor rotor fixedly secured to said cylinder of the compressor, said compression chamber nested within the limits of the motor rotor and said cylinder being eccentrically mounted for rotation responsive to the rotative forces of the motor rotor.

3. A motor compressor assembly comprising a bell-shaped housing with a plate-shaped closure member to provide a hermetically sealed casing, a stud-like support member centrally disposed of the casing, a stationary eccentric, a bearing and an end plate which comprise parts of the compressor and formed integral with said stud-like support member, a rotor mounted on said eccentric for relative rotation therebetween, a compression chamber, a rotatable cylinder eccentrically mounted in respect to said rotor and surrounding said rotor and eccentric and cooperating with said end plate to define said compression chamber, an inlet leading to and an outlet leading from said compression chamber and a divider located between said inlet and outlet, and an electric motor comprising a stator carried by said closure member, and a motor rotor fixedly secured to said cylinder, said motor rotor defining a torus, said compressor being nested within the inner periphery of said torus, said cylinder being eccentrically mounted for rotation responsive to the rotative forces of the motor rotor.

4. In a motor compressor assembly, the combination comprising a bell-shaped housing with a plate-shaped closure member to provide a hermetically sealed casing, a stud-like support member centrally disposed of the casing and having portions thereof formed to define a stationary eccentric, a bearing and an end plate which comprise parts of the compressor, a rotor mounted on said eccentric for relative rotation therebetween, a compression chamber, a cylinder eccentrically mounted in respect to said rotor and surrounding said rotor and eccentric and cooperating with said end plate to define said compression chamber, an inlet leading to and an outlet leading from said compression chamber, said stud-like support member having fluid conduits running from said inlet into said compression chamber and forming the suction side of the com-

pressor, a divider located between said inlet and outlet and carried by said cylinder for reciprocation in said compression chamber, and an electric motor comprising a stator carried by said closure member, and a motor rotor fixedly secured to said cylinder, said compression chamber nested within the limits of the motor rotor, said cylinder being eccentrically mounted for rotation responsive to the rotative forces of the motor rotor.

5. A motor compressor assembly comprising a bell-shaped housing with a plate-shaped closure member to provide a hermetically sealed casing, a stud-like support member centrally disposed of the casing and having portions thereof formed to define a stationary eccentric and an end plate which comprise a part of the compressor, a rotor mounted on said eccentric for relative rotation therebetween, a compression chamber, a cylinder eccentrically mounted in respect to said rotor, a cylinder surrounding said rotor and eccentric and cooperating with said end plate to define said compression chamber, an inlet leading to and an outlet leading from said compression chamber, said stud-like support member having fluid conduits running from said inlet in said compression chamber and forming the suction side of the compressor, spring pressed valving means disposed in the suction conduit and operable responsive to suction pressures of the compressor, a divider located between said inlet and outlet and carried by said cylinder for reciprocation in said compression chamber, means including a valve operable responsive to discharge pressures of the compressor for discharging compressed liquid and gases from the compression chamber into the casing and forming the compression side of the compressor, and an electric motor comprising a stator carried by said closure member, and a motor rotor fixedly secured to said cylinder, said compressor within the confines of the volume defined by the motor rotor, said cylinder being eccentrically mounted for rotation responsive to the rotative forces of the motor rotor.

6. A motor compressor assembly comprising a bell-shaped housing with a plate-shaped closure member to provide a hermetically sealed casing, a stud-like support member centrally disposed of the casing and having portions thereof formed

to define a stationary eccentric and an end plate which comprises part of the compressor, a rotor mounted on said eccentric for relative rotation therebetween, a compression chamber, a cylinder eccentrically mounted in respect to said rotor and surrounding said rotor and said eccentric and cooperating with said end plate to define said compression chamber, an inlet leading to and an outlet leading from said compression chamber, said stud-like support member extending through said closure member and having fluid conduits running from said inlet in said compression chamber and forming the suction side of the compressor, a divider located between said inlet and outlet carried by said cylinder for reciprocation in said compression chamber, means including a valve operable responsive to discharge pressures for distributing compressed liquid and gases from the compression chamber into the casing and forming the compression side of the compressor, and an axial air gap electric motor comprising a stator carried by said closure member and a motor rotor fixedly secured to said cylinder, said compression chamber nested within the limits of the motor rotor, said cylinder being eccentrically mounted for rotation responsive to the rotative forces of the motor rotor about said stud-like support member.

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